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PUERTO RICO AGRICULTURAL EXPERIMENT STATION
MAYAGUEZ, PUERTO RICO
Under the supervision of the
UNITED STATES DEPARTMENT OF AGRICULTURE

REPORT OF THE PUERTO RICO AGRICULTURAL EXPERIMENT STATION

1932

Issued January, 1933

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PUERTO RICO AGRICULTURAL EXPERIMENT STATION, MAYAGUEZ

[Under the supervision of the Office of Experiment Stations, United States Department of Agriculture]

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PUERTO RICO AGRICULTURAL EXPERIMENT STATION

MAYAGUEZ, P. R.

Under the supervision of the

UNITED STATES DEPARTMENT OF AGRICULTURE

Washington, D. C. January, 1933

REPORT OF THE PUERTO RICO AGRICULTURAL EXPERIMENT STATION, 1932

CONTENTS

REPORT OF THE DIRECTOR

By T. B. McClelland

RÉSUMÉ

The station work progressed satisfactorily, although the need for additions to the staff was keenly felt. During the past two years the station staff of technical workers has been the smallest in 25 years, a period covering almost the life of the station. With the advent of the new fiscal year the staff will be further curtailed.

The largest sugar crop in the history of Puerto Rico was produced in the fiscal year 1931–32. This maximum production resulted from various causes, including principally the introduction of, and the shift to, improved sugarcane varieties, and the employment of improved cultural practices. The station may claim a creditable part in this advance and is directing its efforts toward the production of varieties giving increasingly high yields with a resultant reduction in the cost of producing the sugar.

The coffee planters are slowly beginning to recover from the hurricane damage of 1928 and are looking forward to production from new plantings. Their economic condition is still very poor, however. Recovery has been greatly aided by the work of the station.

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Since 1916 the station has maintained in San Juan an office to carry on investigations with citrus and with pineapples, and to help the planters to solve their problems. H. C. Henricksen, agriculturist in charge of the office since its establishment, has given the fruit growers full measure of willing help and valuable counsel. On June 30, 1932, Mr. Henricksen retired from Government service.

The agriculturist continued station projects on which he had previously worked and assisted the insular commissioner of agriculture and commerce in developing the extension service of his department. Studies of the absorption of salts by citrus roots and of the rate of movement of the absorbed material in the plant tissues indicated the advisability of uniformly distributing the salts in fertilizer applications. The irrigation of citrus trees, on both fertilized and unfertilized areas, following a drought, resulted in new growth and the production of blossoms. Bay-oil investigations were continued, and recommendations were made on the findings.

The work of the plant breeding and of the chemical departments of the station was concerned principally with sugarcane, which occupies first place in the agriculture of the island.

P. O. J. 2878, a variety of sugarcane introduced into the island from Java by the station in 1927, has become the outstanding variety in several districts. In the San German Valley it produced nearly a ton of sugar more per acre than did the varieties P. O. J. 2725, P. O. J. 2714, and B. H. 10/12, with which it was compared. P. O. J. 2878 gave better results on heavy clay than on loose, sandy soils. The juice of P. O. J. 2878 showed unsatisfactory purity when the cane was grown on poorly drained lands, or on lands subject to overflow. A special study of the relation of the mineral constituents, particularly the phosphoric acid, in the juices to their variation in quality was begun.

More than 88,000 cuttings of Mayaguez seedling varieties of sugarcane, resistant to mosaic, were distributed to farmers and to sugar centrals on the island. Varieties developed by the station, with Mayaguez 28 (P. O. J. 2725×S. C. 12/4) holding first place, now occupy over 1,100 acres on the island.

Mayaguez 28 has the following valuable characteristics: It germinates well; has a spreading-early-growth habit and rapidly closes in, resulting in a reduction in cultivation costs; stools prolifically; does not uproot; is apparently immune to mosaic and resistant to the leaf-spot diseases; markedly withstands drought; is high in sucrose content of the juice; and ratoons excellently.

Mayaguez seedlings were grown in 14 variety tests in various parts of the island, in cooperation with the insular department of agriculture, with sugar centrals, and with planters.

Field corn from the Isabela district was found to be superior to that from other districts. Ear selections were made with respect to weight and to soundness of kernel. The insular department of agriculture cooperated in this work. Further efforts were made to develop a sweet corn that will prove to be well suited to local conditions.

From November to February, inclusive, the precipitation in the vicinity of Mayaguez was a little more than 5 instead of the normal 13 inches. These abnormally dry conditions were unfavorable to

certain livestock parasites as was shown by examination of slaughtered cattle. Measures were recommended for the control of the nodular worm in calves, a parasite of great importance in Puerto Rico. Study of the life history of the tapeworm of cattle and of goats was continued.

Records of milk and butterfat production by the station herd of registered Guernseys were continued. (Fig. 1.) These records are of value in indicating what may be expected from such a herd in the Tropics. The free service of purebred bulls continued to be an

FIGURE 1.—Station herd of registered Guernsey cows

important factor in the improvement of the local livestock. *Crotalaria usaramoensis*, grown for forage and fed in the succulent stage, did not prove to be palatable to the cattle. Para grass, guinea grass, Guatemala grass, and elephant grass were planted to furnish additional forage.

Further details regarding improvement of equipment and progress in various lines of work are given in the following pages.

BUILDINGS AND IMPROVEMENTS

The principal improvements to the station plant, other than in field work, were the erection of a greenhouse (fig. 2), the installation of a fire-protection system, and the enlargement of the reservoir for irrigation purposes. The reservoir was stocked with small fish (*Pœcilia vivipara*), which have completely controlled the development of mosquito larvæ in the water.

TERRACING

The damage due to soil erosion is very great in Puerto Rico, but little attention has been paid to means of lessening it. During the

year the station began some experimental terracing to prevent surface washing, planting on the slopes *Cordyline guineensis*, which makes under varied conditions of soil, light exposure, and elevation a dense mat of growth which should effectively check erosion. (Fig. 3.)

AVOCADOS

In September an experimental planting of 90 trees, mostly of the Guatemalan varieties of avocado, was made on a leased area in the Guayanilla district which offers great promise for the commercial production of the fruit.

FIGURE 2.—Newly erected greenhouse

COFFEE

SHADING

Experiments to determine the best practice in shading coffee were begun during the year. In preparation for these plantings the plants were vegetatively propagated from upright branches of seedling trees of typical Arabian coffee. For each individual in the test a cylinder of soil 6 feet in diameter and 2 feet deep was removed. (Fig. 4) The soil for refilling the pits was mixed in small quantities, and an equal quantity of each mixture was distributed in each of the pits comprised in the group to be planted to a single clon. The trees were placed to receive three different light exposures. One lot was fully exposed to the sun, and two were shaded by a lath house. (Fig. 5.) For the lighter shade, the laths were spaced the width of one lath apart, and for the heavier shade the spacing was one-half lath width apart. The three lots were identical in respect to the clons contained. With the elimination of seedling variation and with the major reduction in soil variation, differences in development and in production resulting from differences in light exposure should become evident under conditions favorable for growth.

For some years the station has recommended the planting of *Gliricidia sepium* for trial as a coffee shade tree. The mature wood

of the tree is very hard and can be cut for use as fencing, as charcoal, and for the construction of small buildings. During the year 220,000 seeds of *G. sepium* were distributed to planters.

VEGETATIVE PROPAGATION

In certain kinds of experimental work with coffee the use of clons is desirable. Several methods were tried in propagating the clons. In one test plantings were made of 240 softwood cuttings each having 2 to 6 nodes and measuring up to 1 foot in length, consisting principally of tips or suckers each with 3 or 4 nodes; 42 cuttings of wood of intermediate maturity, turning from green to brown; and 60 cuttings of hardened wood up to one-half inch in diameter, most of them being less than 1 foot in length. Half the cuttings were planted in sifted decayed coconut fiber and the other half in washed gravel. Further differentiation in treatment was given by watering one-third of the cuttings with tap water, and two-thirds of them

FIGURE 3.—Terraced hillside

with acetic-acid solutions of 1 part in 1,000, and 1 part in 10,000, respectively. After one month 18 per cent of the cuttings in gravel, and 38 per cent of those in coconut fiber, were alive. After two months these percentages were reduced to 4 and 11, respectively, and after three months to 1 and 7. After four months, 4 per cent of the cuttings were still alive. These were removed but were found to have formed no roots. The cuttings were replaced in the media. At the end of six months 2 per cent of the cuttings were alive but had failed to develop roots.

In the second test a girdle of bark one-eighth to one-fourth inch wide was removed from 100 upright shoots of pencil thickness or less. A small cardboard flowerpot was adjusted over the girdle and filled with decayed coconut fiber. The shoots were watered in dry weather. After two months no roots had developed. As new bark began to bridge the girdles a new girdle of bark one-half inch wide was removed from immediately below the original girdle. Two months later roots had developed in only one instance.

For the next trial the stem was slit upward and a small stone was used to hold the cut open. A carton pot was then fitted around

this opening and filled with decaying coconut fiber. Three to four months later 26 plants had rooted and 66 had failed to root.

A fourth lot was treated in the same manner as the preceding. The stems were upright and of pencil thickness or larger. At 20 weeks 80 of the total of 153 stems had rooted. Air-layering in the manner just described was shown to be a successful method of vegetatively propagating coffee.

YAMS

In March, 1926, when the yam crop (*Dioscorea* spp.) was dug, 66 individuals, including both high and low yielders of the varieties Potato, Tongo, Purple Ceylon, Sealtop, and S. P. I. Nos. 46801 and

FIGURE 4.—Pits dug in preparation for coffee planting in a shading experiment. In the foreground the plants will be unshaded. In the lath house in the rear the plants will be shaded

47001, were selected to test the quantitative production of their progeny as an indication of possible bud variation. Strains showing irregularity in high or in low production were eliminated as they appeared. In the 1931 crop further selection was made by using seed pieces from the highest-producing plants for strains under test for high production, and likewise seed pieces from the lowest-producing plants for low production. In the latest crop the highest average yields with Sealtop and with Potato were obtained from strains that previously gave consistently low yields.

For the several years during which the experiment has been in progress only two strains, both of the variety Potato (*D. esculenta*), have remained consistently high or consistently low in production. Except for these two instances, selection of seed pieces according to strain or from an immediate predecessor of either high or low yield has appeared to be without significance with respect to the succeeding

crop. In the latest crop the most productive variety was one of local derivation and only recently acquired by the station. Locally it is termed "Morado" from the purple color below the epidermis, although the flesh is white or cream colored. The average production of this variety was 8.5 pounds of tubers per plant, whereas the minimum and the maximum individual productions were, respectively, 4¼ and 22 pounds.

DASHEENS, TAROS, AND YAUTIAS

In the 1931 crop of dasheens, taros, and yautias, applications of 2 to 3 ounces per plant of mineral fertilizers failed to show significant differences that could be attributed to fertilizer treatment. The

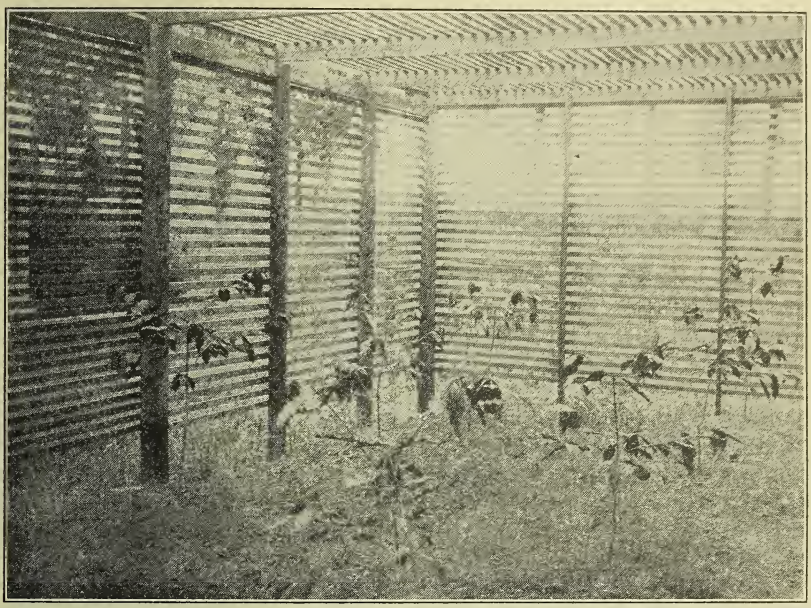

FIGURE 5.—Vegetatively propagated coffee plants shortly after they were set. In the more densely shaded part of the house the laths are closely spaced, as in the panel at the extreme left

amount of fertilizer was doubled for the present crop, the standard application being 2 ounces each of ammonium sulphate, superphosphate, and potassium sulphate. The beneficial effect of potash was pronounced. Increases in yield ranged from 33 to 94 per cent where potash was included in the fertilizer mixture, whereas no increase in yield followed the use of nitrogen and phosphoric acid without potash.

The maximum production of dasheens followed the applications of nitrogen, phosphorus, and potash (NPK). Calculated on the basis of a complete stand, the freshly dug corms and cormels weighed at the acre rate of 17½ tons. The Penang taro, similarly fertilized, produced at the same rate; and the manured taro produced slightly more than the mineral-fertilized. However, if the production of the treated rows is considered only in relation to their checks, applications at the rate per hole of 10 liters of stable manure produced even

greater increases in dasheens than did mineral-fertilizer treatments. A guard row was planted on both sides of each treated row and adjacent to each guard row there was an untreated row. The two untreated rows, separated from the treated row by only the guard row, constituted the check. Each treatment was repeated four times in different parts of the field.

In each of the 12 dasheen rows that received potash in the fertilizer combination, and in each of the four rows that received manure, the average yield surpassed that of both check rows, the average increases being 72 per cent from phosphorus and potash (PK), 81 per cent from nitrogen and potash (NK), 94 per cent from nitrogen, phosphorus, and potash (NPK), and 100 per cent from manure. The same result was had with the Penang taro in 11 of the 12 rows, with minor differences in percentages of increased yield, and also in respect to yautias for each of the 12 rows with smaller increases, however, in yield, 33 to 44 per cent.

In the four rows fertilized with nitrogen and phosphorus (NP), the treated dasheens surpassed both checks in only two instances, whereas the treated Penang taros and yautias failed to do so in a single instance. The average yield of dasheens in the treated rows was the same as that of the check, whereas the yield of the treated Penang taros and of the yautias fell below that of the check.

REPORT OF THE ASSISTANT CHEMIST

By J. O. Carrero

STUDY OF SUGARCANE VARIETY P. O. J. 2878

During the 1930–31 season the sugarcane variety P. O. J. 2878 compared favorably with the varieties B. H. 10/12, S. C. 12/4, and P. O. J. 2725, both in respect to tonnage and to sucrose content. However, complaints were frequently heard about the quality and the defecation rate of its juices. These complaints were surprising, because the work done by the station during the season of 1930–31 showed P. O. J. 2878 to be a heavier feeder, especially with respect to phosphoric acid, than were the other varieties with which it was compared. The phosphoric acid content of a cane juice is of great importance in its defecation. Often juices from P. O. J. 2878 from a certain locality were found to have a phosphoric acid content of 30 to 35 milligrams per 100 cubic centimeters, whereas other varieties from the same locality had 15 to 22 milligrams. It is true that in some localities the phosphoric acid content of P. O. J. 2878 was only 6 to 12 milligrams per 100 cubic centimeters, despite good growth and fairly good juice considered with respect to sucrose content only, but at the time of this determination the phosphoric acid content of the other sugarcane varieties was as low or lower. P. O. J. 2878 has the second highest value ever recorded in the station laboratory, giving on one occasion as much as 62 milligrams of inorganic phosphoric acid per 100 cubic centimeters and 92 milligrams of total phosphorus.

In an early comparison of the different methods of phosphoric acid determination, great differences were often found between the total phosphoric acid content and the phosphoric acid present in

inorganic form in the juices. In this discussion inorganic phosphorus or phosphoric acid means that portion of phosphorus in the juice that is readily precipitated with ammonium molybdate or with calcium hydrate, whereas total phosphoric acid means the total phosphorus in the juice after the organic matter has been destroyed. Both are expressed as milligrams of phosphoric pentoxide (P_2O_5) per 100 cubic centimeters of juice.

Examination of cane juices was continued during the season 1931–32, and special attention was given to those from localities in which P. O. J. 2878 was compared with other varieties. Samples used for analyses were taken from the crusher and from first-mill juices and in every instance represented several wagonloads or several tons of cane. Thus, the results may be considered as representative of the cane from the particular field or locality in which it was grown. All the samples analyzed were from lands belonging to Central Coloso and to persons supplying this mill, and were representative of the different types of soil found between Rincon, Aguada, Aguadilla, and Isabela.

Cane juices of the 1931–32 season were analyzed for their content of inorganic and total phosphorus, and lime, and occasionally also for potash, the results being expressed in milligrams per 100 cubic centimeters of juice. The inorganic phosphorus content of these juices differed considerably from that of the season 1930–31, the difference being in favor of the latter. The large decrease this year in the inorganic phosphorus content of the juices—that form of phosphorus of prime importance in juice defecation—was remarkable when it is considered that in many instances the content was only one-half to two-thirds as much as that of last year. The same condition held for the total phosphorus content, which in very few instances equaled that of last year. In fact, the total phosphorus content of the juices was lower this year in many instances than was the inorganic phosphorus content last year. The inorganic phosphorus content of last year was only one-half to two-thirds that of the total phosphorus whenever the former rose to 25 milligrams per 100 cubic centimeters of juice.

As was the case in 1930–31, there was a difference between the inorganic and the total phosphorus content of the juice, but ordinarily the difference was smaller than that previously recorded, the inorganic phosphorus for the season 1931–32 often amounting to nine-tenths of the total phosphorus. Thus, during the present year the general tendency appeared to be a decrease in the total and in the inorganic phosphorus content of the juices, and also in the difference between the two kinds of phosphorus. However, the ratio between the two kinds of phosphorus was not constant. As the total phosphorus diminished in amount the difference between it and the inorganic phosphorus decreased, whereas as the total phosphorus content grew larger, the difference between it and the inorganic phosphorus increased. In the latter instance the inorganic phosphorus increased also, but to less extent than did the total. Thus, in some instances the total content was 80 milligrams per 100 cubic centimeters, whereas the inorganic content was only 40 to 66 milligrams. On the other hand, juices with a total content of 6 to 11 milligrams

per 100 cubic centimeters usually contained 5 to 10 milligrams, respectively, of the inorganic phosphorus.

In making the analyses for both forms of phosphorus in the juices, the presence of a large amount of waxy substance was often noted on the filter after the phosphate precipitate had been dissolved. This differed with the different sugarcane varieties, being most noticeable with P. O. J. 2878 and with P. O. J. 2725, in the order named. The analyses for lime brought out indirectly another difference between the juices from different localities. After the juices had been evaporated and the residues ashed, dissolved in acid, dried, and redissolved, the residues of insoluble silica remaining differed considerably for the different varieties. Sometimes the juices of the same variety also differed considerably, depending upon the locality in which the cane was grown. In some instances the content was rather heavy, and in others it amounted to only one-half as much. The increase or decrease in silica seemed in some instances to be followed in inverse proportion by changes in the phosphoric acid content of the juices.

The differences in the lime content of the different varieties were small and inconstant, the amount present increasing or decreasing depending on the locality in which the cane was grown. In many instances the lime showed a tendency to increase as the phosphoric acid increased; however, this was not constant since some samples with the highest phosphoric acid content had the lowest lime content.

Since the samples analyzed received comparatively similar treatment as to fertilizer, culture, and irrigation, and were of the same age when cut, but differed as to conditions of soil and locality, the difference in results apparently were to be ascribed to differences in the soils in which the canes grew. Whereas the cane growth may not be injured greatly, or the sucrose and purity of the juice seriously affected by the reaction of the soil toward certain fertilizers, the inorganic composition of the juice may be markedly affected, thus increasing the difficulties of factory practice and reducing the final output. Thus, full benefit can not be received from the new varieties so long as they are planted in all kinds of soils and are treated with the same kinds of fertilizers in all localities. Changes in the amounts of fertilizers applied, the kind used, and the practice followed in accordance with the needs of each locality would probably result in considerable improvement in the quality of the juice.

The method used to determine the inorganic phosphorus content was outlined in the 1930 report.[1] However, the operation of filtering and washing the precipitates of the mixtures of aluminum phosphate and hydroxide by this method were found to require considerable time. The operation could be accelerated by adding to the mixture either calcium carbonate or magnesium sulphate before precipitation. After several tests were made a solution of a mixture of magnesium chloride and aluminum sulphate was prepared of such strength that 5 cubic centimeters of the mixture was enough to precipitate 100 milligrams of phosphoric acid. The solution to be analyzed was heated nearly to boiling, at which time 5 cubic

[1] CARRERO, J. O. REPORT OF THE ASSISTANT CHEMIST. Porto Rico Agr. Expt. Sta. Rpt. 1931 : 11. Illus. 1932.

centimeters of the mixture was added, and then 5 cubic centimeters of ammonium hydroxide. After being boiled for 2 or 3 minutes the solution was cooled, and 5 cubic centimeters of ammonia was added and the whole allowed to stand for 2 or 3 hours in a cool place. The mixture filtered rapidly, and the filtrate was clear. After the precipitate was dissolved in nitric acid, the phosphoric acid was precipitated with ammonium molybdate. The method was tested against the Springer and Davies [2] method and against that adopted in 1930–31. In every instance it yielded closely concordant results, and the phosphorus pentoxide was 0.6 to 1 milligram higher than that under the Springer and Davies method or when aluminum sulphate alone was used.

A slight modification of the method was used for total phosphoric acid, lime, and potash determinations. A considerable amount of sugar remained and had to be destroyed when the samples were allowed to ferment naturally, or were inoculated with a pure yeast culture. To avoid this the sample to be analyzed was measured and heated to boiling and then boiled for two or three minutes. An equal amount of water was added to the sample after it had cooled and the mixture was then inoculated with yeast. Within five to seven days the fermentation had stopped and only very small amounts of sugar remained undecomposed. Thus, the addition of small amounts of magnesium nitrate was needed to cause the organic matter to decompose when the juices were analyzed for phosphoric acid content.

The methods outlined above are not the rapid kinds ordinarily used in the laboratories of the centrals, and they require equipment which usually is not readily available. These methods, however, are more reliable than the others for the accurate determination of phosphoric acid, lime, and potash in the juices, the knowledge of which is of great importance for intelligent fertilization in sugarcane culture.

REPORT OF THE PLANT BREEDER

By R. L. Davis

SUGARCANE

Sugarcane varieties developed at the station were tested in comparison with imported varieties; mosaic-resistant seedlings that have been under observation for seven or eight years were distributed and the areas in them extended; preliminary, semifinal, and final experimental trials with Mayaguez seedlings were made in cooperation with sugar centrals in various parts of the island; and preliminary trials were made at Mayaguez with first-year, second-year, third-year, and fourth-year seedlings. Experimental trials were also conducted in cooperation with the insular department of agriculture.

TESTS OF INTRODUCED VARIETIES

P. O. J. 2878 was the outstanding variety of the year in several districts of the island, including the San German Valley and up-

[2] Springer, H. B., and Davies, J. G. [The chemist's corner.] Determination of phosphates in sugarcane juice. Sugar [New York] 29: 335. 1927. Also Jour. Soc. Chem. Indus. 46: 143T–144T. 1927.

land fields near Centrals Coloso, Constancia, and Carmen. In general field trials, as well as in a controlled experiment on the property of Russell & Co., near Hormigueros, P. O. J. 2878 produced nearly a ton more per acre of sugar than did other varieties including P. O. J. 2725, P. O. J. 2714, and B. H. 10/12.

In the lowlands along the north coast P. O. J. 2878 gave excellent tonnage but a low purity. The station chemist cooperated with the plant breeder in collecting data to determine the reason for this unsatisfactory behavior. According to general field results, P. O. J.

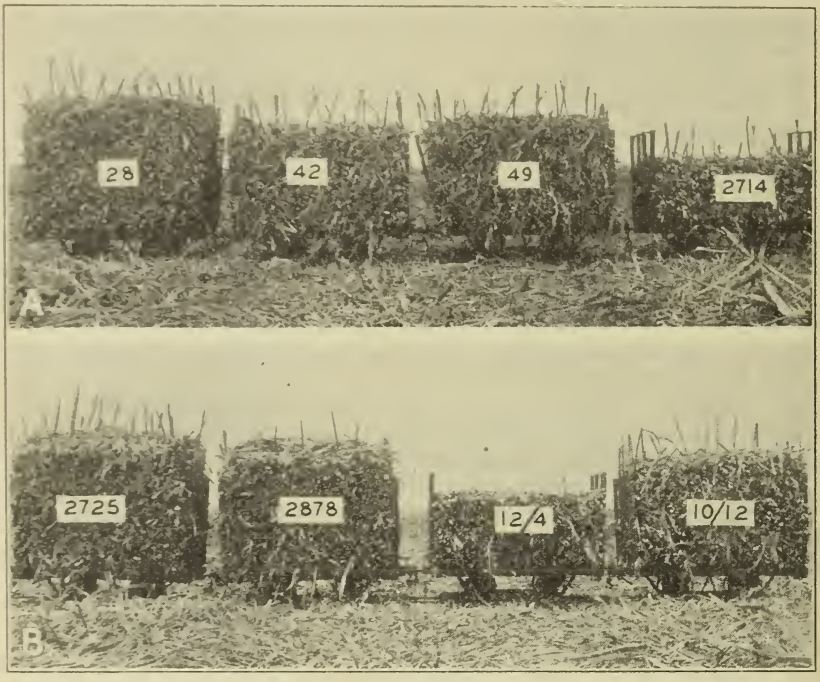

FIGURE 6.—Mayaguez 28 compared well with B. H. 10/12, P. O. J. 2878, and P. O. J. 2725 in cane production at Coloso. Each car carried the cane production of a 1/20-acre plat of each variety in series No. 5 of the variety experiment conducted in cooperation with Central Coloso. The cars were arranged in the same order as were the plats. Mayaguez 28, P. O. J. 2878, B. H. 10/12, and P. O. J. 2725 were superior in cane production, whereas P. O. J. 2714 and S. C. 12/4 were failures

2878 requires good drainage to give a satisfactory purity. On lands that do not drain well or that are subject to overflow, the sucrose content of B. H. 10/12 is the more dependable. In general, P. O. J. 2878 gave better results on heavy clay soils than it did on loose sandy soils.

P. O. J. 2714 has, except in a preliminary trial under drought conditions near Boqueron where it made a fine showing, given results inferior to those secured either with P. O. J. 2878 or with P. O. J. 2725. In the Coloso experiment with sugarcane harvested in April, 1932, where each variety was replicated eight times in 1/20-acre plats, P. O. J. 2714 was a failure, producing only half as much cane as did Mayaguez 28, P. O. J. 2878, and P. O. J. 2725. (Fig. 6.)

In the Filial Amor experiment, conducted by Russell & Co., and the insular department of agriculture, P. O. J. 2714 produced only

7.98 tons of sugar per acre as compared with 10.07 tons for P. O. J. 2878, and 8.32 tons for P. O. J. 2725. Not only was the cane production of P. O. J. 2878 in the six replicated $\frac{1}{20}$-acre plats greater than that of P. O. J. 2714 and of P. O. J. 2725, but the sugar yield also was higher. P. O. J. 2878 gave an average sugar yield of 12.97 per cent, whereas P. O. J. 2714 gave 11.53 per cent, and P. O. J. 2725 gave 10.89 per cent.

P. O. J. 2714 developed poorly at Hormigueros, Filial Amor, Mayaguez, and Coloso. Its root system showed a marked tendency to dry out. In view of the inferior behavior of P. O. J. 2714 in controlled experiments and its weak root system, this variety can not be recommended for general planting on lowland cane areas either under irrigation or partial irrigation. (Fig. 6.) P. O. J. 2725 was selected and distributed in preference to P. O. J. 2714 at Mayaguez in 1924 and again in 1925. The preliminary observations made then indicated that P. O. J. 2714 was less vigorous and less productive than P. O. J. 2725. All variety trials made since have justified the selection of P. O. J. 2725 as the better of the two varieties.

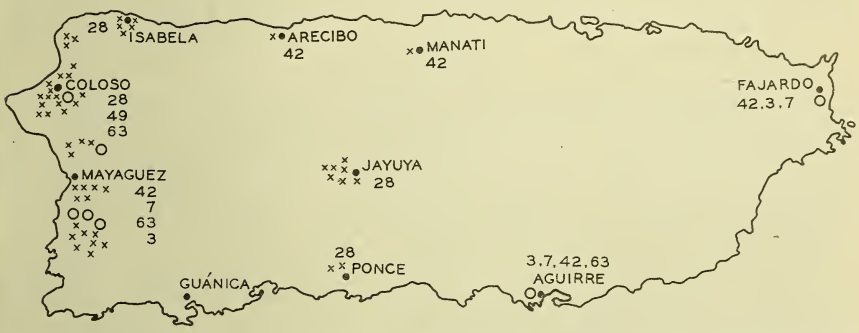

FIGURE 7.—Cane hybrids occupied 500 acres in December, 1931. Each cross represents 10 acres of commercial plantings of Mayaguez seedlings and each circle 5 acres in experimental plats of Mayaguez seedlings grown in comparison with a standard variety. The number of each Mayaguez seedling is listed in the locality in which it grows. The sequence for Coloso and for Mayaguez is according to area

DISTRIBUTION AND COOPERATIVE TESTS OF MAYAGUEZ SEEDLINGS

Mosaic-resistant seedlings.—During the year 88,600 cuttings of Mayaguez seventh-year and eighth-year mosaic-resistant seedlings were distributed, 1,500 being sent to 80 farmers for propagation, and 87,100 in lots ranging from 500 to 10,000 each to sugar centrals and to large private growers for controlled variety experiments. In December, 1931, as illustrated on the map (fig. 7), the Mayaguez seedlings occupied 500 acres. The number of each Mayaguez seedling is listed in the locality in which it grows, and the number of the seedling occupying the largest area is placed at the top of its respective list. By April, 1932, this area had more than doubled, having a total of 1,135 acres. The increase was largely due to the rapid extension of Mayaguez 28 which occupied 890 acres. Mayaguez 42 was second with 134 acres, and No. 7 third with 66 acres. Because of its strong root system and prolific stooling habit which retards soil erosion, Mayaguez 28 has proved to be well adapted to steep-hillside cultivation near Jayuya.

Seventh-year and eighth-year seedlings.—In cooperation with the insular department of agriculture, various sugar centrals, and planters, the station made 14 variety tests with Mayaguez seventh-year and eighth-year seedlings in different parts of the island. However, the cane from only 4 of these was harvested in 1932, 2 at Aguirre, 1 at Coloso, and 1 at Pagan. At Aguirre, primavera or spring-planted canes were harvested in April when 11 months old. In cane production Mayaguez 63 was superior, and Mayaguez 3 and Mayaguez 7 were inferior, to B. H. 10/12. In sucrose content B. H. 10/12 was superior to all four Mayaguez seedlings. Under good cultural conditions and with a plentiful supply of water for irrigation, B. H. 10/12 does better at Aguirre than do any of the new varieties so far tested, with the possible exception of P. O. J. 2878.

At Coloso[3] gran cultura or fall-planted cane was harvested when 18½ months old. B. H. 10/12 did not give so high a sucrose content as did either Mayaguez 42 or Mayaguez 49. As an average for the eight replicated ⅒-acre plats, Mayaguez 28 was superior in sugar production per acre to Mayaguez seedlings 49, 42, 3, and 7. (Fig. 6.) The superior tonnages of Mayaguez 28, P. O. J. 2878, P. O. J. 2725, and B. H. 10/12 over those of P. O. J. 2714 and S. C. 12/4, illustrated in Figure 6, were typical of the other seven series of plats in the experiment. In sucrose content P. O. J. 2725 was uniformly inferior to Mayaguez 28 throughout the field. Normal-juice analyses of Mayaguez 28 averaged 17.5 per cent sucrose and did not fall below 17 per cent sucrose in any plat, whereas those of P. O. J. 2725 ranged between 15.5 and 16.5 per cent sucrose. There was little difference between the sugar productions of Mayaguez 28, B. H. 10/12, and P. O. J. 2878. The cane in this experiment was grown under partial irrigation on flat lowland. On upland without irrigation somewhat different results would be expected since the drought resistance of Mayaguez 28 gives it an advantage over both B. H. 10/12 and P. O. J. 2878.

At Central Pagan, Mayaguez 3 under irrigation on two 0.38-acre plats[4] yielded at the acre rate of 78 tons of cane, or 8 tons more than did the adjoining plats of P. O. J. 2725. This was gran cultura or fall-planted cane. More replications are necessary as a basis for conclusions on the behavior of Mayaguez 3 in the Anasco Valley. Practically no arrows were observed in the plats of Mayaguez 3. This late to nonarrowing character is considered to be a marked improvement over the early arrowing of P. O. J. 2725.

Third-year and fourth-year seedlings.—Among the third-year seedlings, 7 of the combinations Mayaguez 28×P. O. J. 2878, and 22 of the combination P. O. J. 2725×B. H. 10/12 were selected and planted at Centrals Coloso and Aguirre. These trials are intended as qualitative for preliminary determinations of the sucrose content with a sampler mill. Measurements and counts taken at 8 months indicated that a number of these seedlings were superior to B. H. 10/12 in prolificacy. Among the P. O. J. 2725 × B. H. 10/12 seedlings, six at 8 months were taller than adjoining rows of B. H. 10/12.

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[3] The Coloso experiment was planned by F. Colon Moret, superintendent of cultivation, Central Coloso.

[4] Grown in cooperation with Russell & Co.

The fourth-year trials of the P. O. J. 2364 × Mayaguez 9 seedlings indicate that Mayaguez 151 is the most vigorous of the lot. In each of the replicated ½₀-acre plats at Filial Amor, Mayaguez 151 grew more rapidly than did the adjoining plats of P. O. J. 2878. Other seedlings of promise in this combination are Mayaguez 104 and Mayaguez 132 which have also been planted in control experiments in the San German Valley.

First-year seedlings.—The crosses between P. O. J. 2878 and B. 6835, produced in cooperation with Central Fajardo, were of inferior growth and were therefore discarded. Several selfed seedlings of U. S. 785 were vigorous, and their juices gave a satisfactory hand-mill analysis.

The new first-year progenies include 500 open-pollinated seedlings of Mayaguez 508, 100 seedlings that are presumably crosses between Mayaguez 305 and P. O. J. 2878, 300 open-pollinated seedlings of selection 8 (U. S. 541 × S. C. 12/4), and 60 seedlings of P. O. J. 2725 and Co. 281 secured from arrows supplied by Central Fajardo. Most of these seedlings are very prolific and since they contain a high proportion of Kassoer are to be tested on saline soils where Kassoer seedlings thrive.

ARROWING

The varieties B. H. 10/12, P. O. J. 2878, Kassoer, and Badilla were grown in barrels at Mayaguez. None of these varieties blossomed in the arrowing season, November, 1930, to January, 1931,[5] although from November 15 to 30, the period during which most varieties blossom in Puerto Rico, the canes were 13 to 14 months old. From November 25 to December 15, 1931, approximately two years after planting was done, every 2-year-old cane of P. O. J. 2878 came into flower. Of 125 canes of Kassoer, only two blossomed and the blossoms opened in January. No arrows or signs of arrowing were observed in 50 canes of B. H. 10/12 and 10 canes of Badilla. The planting of canes in barrels at Mayaguez failed to induce profuse arrowing in late-arrowing types, such as Badilla or B. H. 10/12. Badilla was forced into profuse arrowing, however, by planting it on Las Mesas early in the fall at an elevation of 800 feet. The stools in the breeding plat were watered by hand throughout the dry season to prevent stunting which is unfavorable to arrowing. Of 200 canes of Badilla observed on Las Mesas, over 50 per cent arrowed.

A number of sugarcane varieties under irrigation at Mayaguez in 1930 were held over without being cut until January, 1932. A total of 165 canes of Mayaguez Nos. 189, 132, 112, 129, 104, 204, 145, and 239 which were 11 months old in December, 1930, and did not arrow that season, came into full blossom when 22 to 23 months old in December, 1931. Growing the crop for a long period is more effective in inducing blossoming than is the method of growing canes in barrels.

SUMMARY OF WORK

Among the varieties imported by the station, P. O. J. 2878 in both controlled experiments and in general field trials has proved to be

[5] DAVIS, R. L. REPORT OF THE PLANT BREEDER. Porto Rico Agr. Expt. Sta. Rpt. 1930: 34, illus. 1931.

superior to all other varieties tested in the San German Valley. It has also given good results on compact upland soils near Centrals Coloso, Constancia, and Carmen. Mosaic-resistant Mayaguez seedlings now occupy 1,135 acres in Puerto Rico. The most prominent of these new native varieties is Mayaguez 28, which occupies 890 acres, and which in the controlled experiments at Coloso compared well with B. H. 10 12 both in cane production and in sucrose content. In cooperation with various centrals and with the insular department of agriculture, 14 experimental plantings containing six replications per variety have been made. The cane will be harvested in 1932 to determine the relative value of various Mayaguez seedlings.

FIELD CORN

On the Tomás Garcia farm near Utuado, field corn on 2 acres was planted in cooperation with the insular department of agriculture for comparison of yields of hybrids and native field corn. Fourteen varieties, 9 first-generation hybrids, and 5 unselected corns from different districts, were grown in 2-row series with the Garcia corn grown as the standard variety in every third plat. Each variety was replicated three times in $\frac{1}{36}$-acre plats. The hybrid corns outyielded the Garcia corn by a margin ranging from 12 to 33 per cent. The hybrids, however, showed no significant advantage over unselected Isabela corn. This lot of hybrids was therefore discarded.

Field corn on 4 acres was grown in yield tests near Isabela in cooperation with the insular substation of Isabela. Two trial plantings were not harvested because they made unsatisfactory stands, and a third planting was harvested but was not weighed. The fourth trial, however, confirmed the test at Utuado, which indicated that the hybrids were not superior in yield to unselected Isabela corn. Efforts were therefore centered on Isabela corn.

In cooperation with Director Luis Serrano of the Isabela substation, insular department of agriculture, 750 ears of corn were selected in the Isabela district. They were reselected at Mayaguez for weight and for soundness of kernel. Of the original lot, 350 were retained and tested for early-growth vigor. The ears from the Mayor farm were found to have greater vigor than did those from the Serrano and the Alfaro farms. The Mayor ears were therefore lumped together and sent to Isabela where they were grown on 2 acres for seed production. The corn from the Mayor farm of Isabela is now known as "Mayorbela."

SWEET CORN

Mayaguez 3 sweet corn, a native variety produced from a cross between Mayaguez 1 and inbred starchy lines, was sent to the insular experiment station at Rio Piedras where it was planted for cooperative seed production. The plant growth was vigorous, and the ears showed a marked improvement in uniformity over those of Mayaguez 1 sweet corn. Most of the ears had kernels 1 centimeter or more long with deeply wrinkled crowns, and the proportion of cob was small. (Fig. 8.)

Mayaguez 3 sweet corn was self-pollinated at Mayaguez, and large, healthy sweet-corn plants, free from deleterious charac-

ters, were selected for use in developing uniform breeding stock. Two types predominate in Mayaguez 3 ears—deep keystone, and large, round kernels. Mass selection was made for the former type.

In order to secure increased plant vigor and still greater uniformity in kernel type, Mayaguez 1 sweet corn was crossed with unselected native field corn. Three generations of this cross were grown in the fiscal year ended June 30, 1932. The first two generations were allowed to pollinate inter se, and hybrid kernels were selected from deep keystone starchy dent types. In the third generation 450 of the more vigorous plants were self-pollinated, and selection was made for vigorous plant growth and for large keystone sweet kernels.

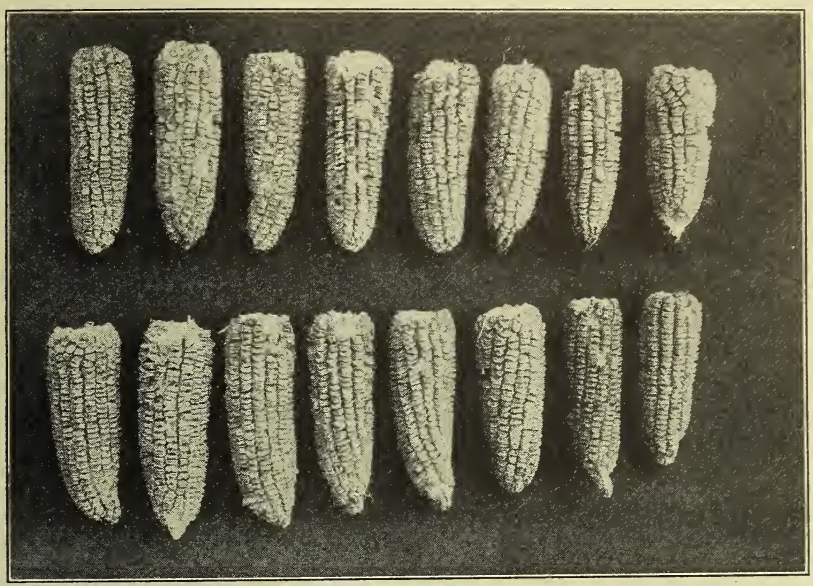

FIGURE 8.—Mayaguez 3 sweet corn. Grown in cooperation with the insular experiment station at Rio Piedras. It is an improvement over Mayaguez 1 both in size and in tenderness of kernel, but lacks uniformity and is not suited for general distribution

REPORT OF THE AGRICULTURIST

By H. C. HENRICKSEN

Anticipating the extension of the Smith-Lever Act to Puerto Rico, the commissioner of agriculture and commerce requested the agriculturist to assist him in developing extension work in his department. The request was granted and an agreement signed by the commissioner and by the director of the station to the effect that one or more men, to be paid from insular government funds, should be appointed to carry on the work of the San Juan office under the direction of the agriculturist. Ramón Negrón, jr., was appointed to do the analytical work connected with the research activities, and Signey F. Mason to devote part of his time to extension work in the packing and shipping of fruits and vegetables.

CITRUS INVESTIGATIONS

ABSORPTION OF ASH CONSTITUENTS BY CITRUS TREES

To study absorption of mineral constituents by citrus trees, different inorganic salts were applied to the soils in which trees of various sizes were growing, and leaves and branches from different parts of certain of the trees were analyzed within a reasonable time following the application of the salts. The method proved to be of value only when the soil was appreciably deficient in one of the ions in the salts used. Lithium nitrate was used with satisfactory results to measure the amount of absorption by roots and to determine the rate of movement of the absorbed salts in the tissue. The lithium was determined by means of a spectroscope.

The lithium nitrate was applied to definite root areas of the trees, the salt being worked into the soil by hand, and sufficient water added to supply the optimum moisture for root function. The salt was applied to roots in all stages of development, from young fibrous roots to large main roots devoid of fibrous roots. The soil was removed from under the main roots, and paraffined paper was placed underneath the exposed sections, after which a small amount of the lithium salt was applied and the soil was replaced. Using this method the salt could not possibly reach any fibrous root. Examination showed that the lithium was absorbed by all the roots, including the large ones.

The belief is rather general that only fibrous roots absorb fertilizer salts, but this experiment showed that at least some salts are taken in through the root bark. It was also definitely proved in this experiment that lithium enters the tree through the leaves and the bark of the branches. Trees were sprayed with a 5 per cent solution of lithium nitrate, and after 24 hours the epidermis of leaves and branches was stripped off and the underlying tissue was tested for lithium. Lithium was found in the tissues of both the leaves and branches. Spraying with lithium caused the leaves to drop, but since no visible effect was apparent during the first two or three days following spraying, the treatment served the purpose for which it was intended.

Lithium was found to move rapidly from the point in the soil where it was applied to different parts of the tree. Seventy-two hours after lithium had been applied to the soil at a distance of 4 feet from the tree it was found in the extreme tips of branches 25 to 30 feet from the point of application. However, the lithium traveled through the branches only on the side receiving the application, and was not found in the branches on the opposite, or untreated, side of the tree.

Assuming that the amount of absorption and the rate of movement of lithium in plant tissue are similar to those of potassium and calcium, it is concluded (1) that ash constituents may be absorbed to some extent by all roots, even by those that have passed the fibrous stage, (2) that the rate of movement of the ash constituents in a citrus tree allows them to reach all parts of the tree within 48 to 72 hours after application is made, and (3) that the ash constituents move only through the tissue supplied by a definite part of the root system. This emphasizes the need for uniformly distributing the fertilizer salts in the soil.

CONTROL OF TIME OF BLOOMING

Withholding water until the leaves reach the wilting stage to induce dormancy is recognized as a fairly efficient method of producing bloom on citrus trees. Unfortunately dormancy can not be so produced at will by such a method, because rains can not be controlled. Between February 6 and March 19, 1932, the total rainfall at Pueblo Viejo was less than 0.5 inch and the trees became dormant as the result of the deficient rainfall. The trees were watered as soon as the leaves showed signs of wilting, with the following results: (1) Water intake became distinctly visible in the appearance of the leaves within 10 hours after the trees were irrigated; (2) fertilizer salts, measured by the lithium method previously mentioned, reached all parts of large trees in 48 to 72 hours after their application; and (3) the buds on the irrigated trees had swelled in 4 days following the application of water and had opened 2 days later. These data were checked in several groves, and in all instances bloom buds and new leaves were seen within 7 days after the water was applied.

Fertilizer salts were not so active as was water in promoting new growth. New growth started as rapidly on trees that were watered but not fertilized as on trees to which both water and fertilizer were applied. The amount and kind of growth and of bloom appeared to be the same for both fertilized and unfertilized trees. This point could not be definitely determined, however. It was observed that trees fertilized either at the time they were watered or a few days later shed less bloom than did trees receiving no fertilizer. This was to be expected because the soil had been leached by many heavy rains since the trees were fertilized.

ABSORPTION OF ASH CONSTITUENTS BY SUGARCANE

Tests were made to determine the rate of movement of lithium through sugarcane. The results showed that in no instance did lithium enter the stalk within 12 hours after application was made, but that in every instance the salt had penetrated the whole stalk after 15 to 16 hours. One stalk was 6 feet tall. About 12 hours was therefore required for sugarcane roots to absorb lithium, whereas only 3 to 4 hours was required for it to move completely through a stalk 6 feet high.

PINEAPPLE INVESTIGATIONS

CONTROL OF TIME OF BLOOMING

In different parts of a field 20 to 50 pineapple plants were smoked in the usual manner to induce blooming.[6] Plants were taken to the laboratory once a week during the first six weeks after they were smoked. At the end of six weeks they usually bloomed. Various parts of the plants were tested quantitatively for catalase, diastase, and for reducing sugars. The results did not show changes to which blooming could be attributed. In fact, no change could be detected until the bloom had formed and then it was too late to determine what caused the change.

[6] HENRICKSEN, H. C. REPORT OF THE AGRICULTURIST. Porto Rico Agr. Expt. Sta. Rpt. 1930: 37. 1931.

PRODUCTION OF NEW VARIETIES

Seeds of nine different crosses of pineapples were received from the experiment station of the Hawaiian Pineapple Canners' Association and germinated. The resultant seedlings were potted and first kept at the propagation station of the insular department of agriculture and commerce, but later they were transferred to the experiment station at Mayaguez. Five plants of the wild pineapple of Brazil, received from Estación de Pomicultura, Deodoro, Rio de Janeiro, appeared to be promising for crossing. Twenty plants originating in different parts of the world were received through the Division of Foreign Plant Introduction of the United States Department of Agriculture. A few plants each of 15 different varieties were received from the United Fruit Co. gardens at Tela, Honduras. All were planted and will be available for cross-pollination later.

BAY-OIL INVESTIGATIONS

Bay-oil investigations were conducted in cooperation with the Bureau of Chemistry and Soils of the United States Department of Agriculture. Samples of fresh bay leaves and of oil, secured from the plantation of Enrique Veglio, at Patillas, Puerto Rico, were sent to the bureau for test. Planters were instructed how to identify bay trees producing lemon-scented leaves.[7]

All essential data dealing with the operation of the plantation stills were obtained and compared with similar data from a laboratory still with the result that the following recommendations were made: (1) Baffles should be placed in the still heads to lessen the volume of solids in the distillate; (2) the still should be provided with distillate receivers of about 20-gallon capacity; (3) pipes should be installed to carry clear water to the receivers; and (4) the oil should be filtered through filter-cel under vacuum. The oil and the water in the distillate do not separate perfectly, some of the oil always remaining emulsified with the water. Experiments in the laboratory showed that a perfect separation can be secured by placing in the receiver equal amounts of water and distillate.

All these recommendations were carried into effect on the plantation under Mr. Negrón's supervision with marked improvement in the process and the product. A distillate nearly free from solids was obtained, emulsification was entirely overcome, and the color of the oil after it was filtered through filter-cel was light as compared with that produced by the old method of filtering.

Experiments were also made to learn what difference in yield of oil and in time of distillation is produced by grinding and by cutting the leaves. Leaves run through a feed cutter produced less oil when distilled for 5 hours than did whole leaves when distilled for 4½ hours. Grinding the leaves in a hand cane mill was not successful because the grooves in the rollers clogged. The results are not conclusive, but they indicate the advisability of distilling whole rather than ground leaves.

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[7] HENRICKSEN, H. C. REPORT OF THE AGRICULTURIST. Porto Rico Agr. Expt. Sta. Rpt. 1931 : 23. 1932.

A test was made to determine the difference in yield of oil from mature and from immature leaves. A charge of 550 pounds of leaves and 300 gallons of water, when distilled for 4½ hours, yielded about 60 gallons of distillate. The mature leaves yielded 2,270 cubic centimeters of oil, and the immature leaves, 1,950 cubic centimeters. Probably the use of tender, young leaves would have given a still greater difference.

A test was made to determine the difference in yield and in quality of oil from freshly picked and from stack-burned leaves. The leaves undergo changes by fermentation due to heating when they are kept for two days or more in sacks or in piles. The visible effect of such fermentation is a change of color from green to yellow or to brown. A charge of 550 pounds of leaves and 300 gallons of water was distilled with the following results: The fresh leaves yielded 2,270 cubic centimeters in 4½ hours, and the stack-burned leaves that had been kept in sacks for 60 hours yielded 1,914 cubic centimeters in 5 hours. The test showed that fermentation of the leaves causes a loss in quantity of their oil. Moreover, the oil from stack-burned leaves is not so desirable as that from fresh leaves because of the very dark color of the former.

REPORT OF THE PARASITOLOGIST

By H. L. Van Volkenberg

GENERAL SURVEY

The winter season, October, 1931, through March, 1932, like that of the preceding year, was unusually dry in the vicinity of Mayaguez and, therefore, unfavorable for many parasites. This was especially noticeable in the lessened amount of infestation with stomach worms and with nodular worms in calves. There was also a considerable reduction in the amount of liver-fluke infestation in cattle slaughtered at the abattoirs. Liver lesions caused by the fluke were found in adult cattle, but the parasite itself was not as numerous as in previous years.

A comparison of the summer months or wet season with the past two unusually dry winters and with normal years indicates in general that animals on pasture are more likely to pick up heavy infestations with several kinds of parasites shortly after the close of the wet season than at other times. Apparently heavy rains have an appreciable cleansing action, even in the more level areas, in carrying off infective larvæ, and, likewise, an overabundance of moisture is unfavorable for the development of certain parasites.

Many cattlemen who have paid high prices for improved dairy cattle are finding that they are raising only a small percentage of the calves from them. These valuable animals require better care, more nutritious feed, and more protection from parasites and from disease than do the native cattle. Many of the requirements may be met by raising such animals in more favorable localities.

The southern portion of the island with its dry climate and abundant growth of guinea grass is more favorable for the raising of young cattle free from parasitic infestation. Guinea grass is superior to the other native grasses, especially for growing animals. The

islands of Vieques and St. Croix are comparatively dry areas with abundant guinea-grass pastures and are very favorable for cattle.

During April, 1932, Maurice C. Hall, of the Bureau of Animal Industry, United States Department of Agriculture, visited Puerto Rico, under the auspices of the School of Tropical Medicine, to study the parasite situation. One of the more important problems considered by Doctor Hall was the possible control of the liver fluke in cattle and in goats, and of schistosomes in man, by a campaign for the destruction of the kinds of snails harboring these parasites. The following is from Doctor Hall's manuscript report:

> From a scientific standpoint it would seem that such a campaign is entirely practicable and possible. The destruction of both kinds of snails mentioned can be accomplished very easily by the use of copper sulphate. The benefits from snail eradication in the countries in which it has been carried out have been very great. I can only suggest this work of snail destruction is a problem which the United States is attacking at the present time and which Puerto Rico will attack sooner or later. It is the more important here in that it involves human health; and is the simpler problem here to the extent that it is located on an island covering not a large extent of territory instead of being scattered over more than 20 States for thousands of miles.

NODULAR AND STOMACH WORMS

The control of nodular worms in cattle is a problem of considerable importance. The adults of the nodular worm live in the large intestine of the cattle. The larval worms live in nodules in the walls of the large and small intestines. A large percentage of the intestines of cattle in Puerto Rico contain these nodules, showing that infestations by this worm have occurred probably during calfhood. Nodular worms are in some ways a more serious problem than are stomach worms (*Hæmonchus contortus*) for the reasons that a safe and efficient vermicide for the former is not known, and infested animals apparently recover more slowly than do those infested with stomach worms.

Nodular-worm infestation in calves may be partly prevented by raising the calves in pens under sanitary conditions. The feed racks and the water troughs should be protected from fecal contamination. The floors of the pen should be cleansed frequently to prevent the development of eggs in the manure. Manure from infested animals should not be spread on fields unless it is plowed under and buried to prevent infestation of the grass. Grass from fields that receive the wash from higher lands on which cattle are kept may become contaminated with infective larvæ. Protective measures, if persisted in, should keep the infestation of nodular worms down to a point where they do little damage. In addition to the foregoing preventive measures, for stomach-worm control the calves should be drenched once each month with a solution of copper sulphate.

Experiments with treatments for nodular worms have shown that carbon tetrachloride given to calves at the rate of 1 cubic centimeter for each 30 pounds of body weight, repeated at monthly intervals, will, after several treatments, greatly reduce the number of, or remove all, the nodular worms. Food and water should be withheld from the animals for 18 hours before, and for 3 hours after, each treatment. Definite precautions should be used when carbon tetra-

chloride is to be administered to calves, because of its toxic effects on them. Prompt purgation is necessary with each treatment. An equal volume of dry Epsom salts should be given with the drug. Before calves are treated they should be given a well-balanced grain ration and allowed free access to a suitable mineral mixture. Calves that have had a recent and decided change of forage or of pasture should not be treated. Single doses of the drug should not exceed 15 cubic centimeters even when a large animal is to be treated. The drug should not be given to pregnant heifers or to adult cattle. Only two or three calves should be treated at first to determine their toleration for the drug. It should be administered by a competent veterinarian.

The drug will also remove stomach worms, and in repeated doses will remove several other species of worms, except tapeworms, from the small intestine. Fecal examinations occasionally showed that all, or nearly all, the nodular worms in a heavily infested animal were removed by one treatment. The indications are that the mass of food material in the large intestine protects the nodular worm, but occasionally the drug reaches the large intestine in sufficient strength to remove the worms.

TAPEWORM OF CATTLE AND GOATS

A study of the life history of the tapeworm (*Moniezia expansa*) of cattle and goats was continued. Experiments in which dung beetles infested with tapeworm cysts were fed to calves yielded no conclusive results, and likewise the administration to calves of the dry and so-called developed ova of this tapeworm, by placing them in the feed and also in the nostrils of the animals, gave negative results. Manure from infested cattle and from infested goats and ova from fresh, ripe segments of the tapeworm were mixed with fresh manure and kept as nearly as possible under natural conditions for development of the ova for periods ranging from six weeks to six months. No infestation resulted in the calves under test.

The theory that these ova develop in the manure, or in the soil, under favorable conditions of moisture and warmth, and that infestation is direct from the ova to the animals, does not seem to be tenable. The hooks of the embryo of the fresh, ripe ova showed motility. Infestation either directly or through an arthropod or plant intermediate host or both might seem to be from this viable and active embryo. All attempts to bring about direct infestation from the fresh ova were unsuccessful.

Apparent tapeworm ova were found in the wall of the intestine of the cockroach. The hooks in these ova showed motility, indicating that they were viable. Their significance is unknown.

NOTES ON THE STATION DAIRY HERD

By H. L. Van Volkenberg

Table 1 records the milk and the butterfat production of the station herd of registered Guernseys. Except for Lorna and Gerar Tsoie, which were imported as calves, all the cows were born and raised in Puerto Rico.

TABLE 1.—*Milk and butterfat production records for 12 Guernseys at the Puerto Rico station for the year ended December 31, 1931*

Name of cow	Length of time in milk	Total yield of milk	Total yield of butterfat	Proportion of butterfat
	Days	*Pounds*	*Pounds*	*Per cent*
Mayaguezana	303	6,717	244	3.6
Lorna	292	5,973	221	3.7
Gerar Tsoie	284	5,335	215	4.0
Queen	295	4,918	211	4.3
Rose Tsoie	299	4,590	222	4.8
Esmeralda	265	4,147	186	4.5
Galores	365	3,575	180	5.0
Della (heifer)	365	4,719	190	4.0
Diana (heifer)	256	3,649	134	3.7
Estella (heifer)	209	3,292	128	3.9
Linda (heifer)	319	3,200	129	4.0
Marina (heifer)	139	1,819	86	4.7

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